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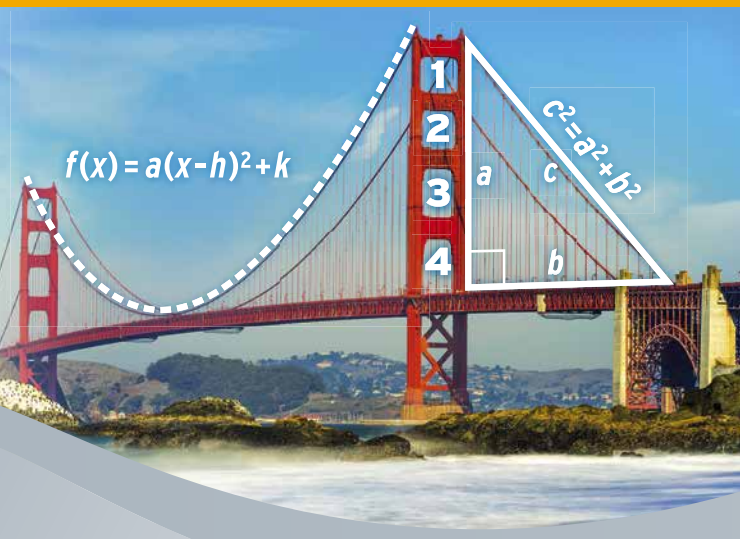

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teaching children mathematics

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Teaching Children Mathematics (***TCM***), an official journal of the National Council of Teachers of Mathematics (NCTM), supports the improvement of pre-K–grade 6 mathematics education by serving as a resource for teachers so as to provide more and better mathematics for all students. It is a forum for the exchange of mathematics ideas, activities, and pedagogical strategies, and for sharing and interpreting research. NCTM publications present a variety of viewpoints. The views expressed or implied in *TCM*, unless otherwise noted, should not be interpreted as official positions of NCTM. The appearance of advertising in NCTM's publications and on its websites in no way implies endorsement or approval by NCTM of any advertising claims or of the advertiser, its product, or services. NCTM disclaims any liability whatsoever in connection with advertising appearing in NCTM's publications and on its websites.

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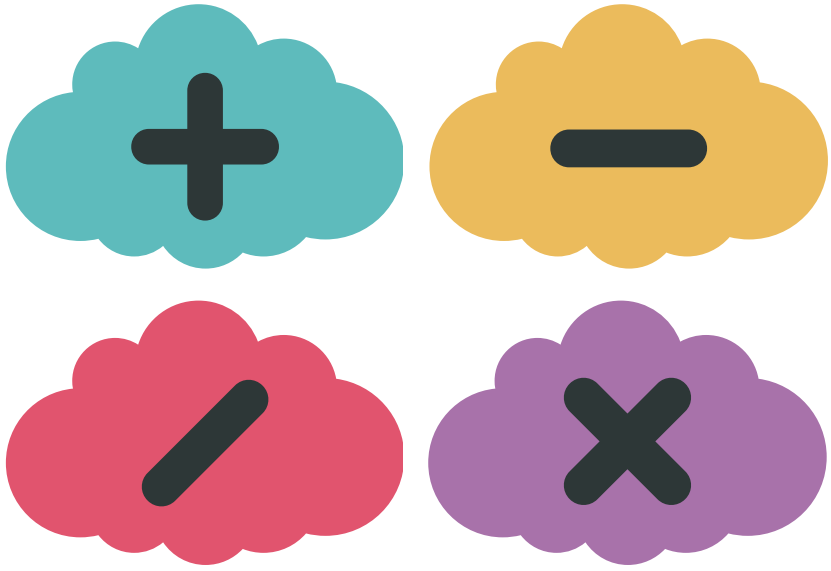
Common Core brief: The fraction progression*



LISA ENGLARD

The Progressions Documents of the Common Core State Standards for Mathematics (CCSSM) (CCSSI 2010) present narratives that detail the progression of a math topic and how knowledge of each topic develops across grade levels. The progression for fractions describes how students build on early experiences with partitioning to extend their understanding of number and operations.

Grades 1–3

In grades 1 and 2, students engage in preliminary geometry work focused on creating equal parts and identifying the whole. They partition shapes into halves, thirds, and fourths; reason about the relationship between the number of shares and the size of each share; and recognize that equal shares need not have the same shape.

Instruction in grade 3 quickly transitions from area models to the number line, a linear measurement model where numbers are placed according to their distance from zero. The whole to be partitioned equally is the length of the interval between zero and one. The progression begins by defining the unit fraction and then extends what students know about collections of whole numbers to collections of unit fractions.

Counting

Just as students counted ones, they can count unit fractions, that is, a number, *1/b*, that represents one part when the whole has been partitioned into *b* equal parts. Using the number line, students can count one-third, two-thirds, three-thirds, four-thirds, five-thirds. They notice that three-thirds falls in the same place as the number 1 and that four-thirds falls in the same place as 1 1/3, building understanding of equivalence without the need for algorithms or "improper" fractions.

Comparing

Just as with whole numbers, students understand order on the number line in terms of length and position, where a number on the left is smaller than a number on the right because the segment from zero to the number is shorter. Students understand that fewer copies of the same unit make a lower number. When comparing different unit fractions, they reason that the higher denominator represents a lower number because the same whole is partitioned into more parts, making each part smaller.

Addition

Just as students added ones, they can add unit fractions; so, if 5 represents 5 copies of 1, then 5/4 represents 5 copies of 1/4, and 5/4 + 7/4 is (5 + 7) copies of 1/4. Students recognize

that adding different-size units does not make sense; when adding multidigit numbers, they added ones to ones, tens to tens. Similarly, they can add halves to halves, thirds to thirds. If they need to add halves and thirds, they can partition the numbers into smaller units so that the addends are composed of same-size units.

Subtraction

Students can separate, take away, find how much higher one number is than another, or find a missing addend using the same reasoning developed for fraction addition. They can also extend regrouping; previously students decomposed 100 into 10 tens in a subtraction problem. Now they might decompose 1 into 5/5 if more fifths are needed.

Multiplication

In multiplication with whole numbers, the number of groups and the size of each group were known, and the product represented a total. Now the size of the group might be one-half of a sandwich, or the number of groups might be three-and-a-half pounds of bananas. Reasoning with visual models, students understand that multiplying by one-third is the same as dividing into three equal parts, thus extending the relationship between multiplication and division.

Division

In division with whole numbers, a total was given, and the unknown was either the number of groups, given the size of each group, or the size of each group, given the number of groups. Just as there are five two-cup servings in a ten-cup container, students can also reason that there are twenty half-cup servings. If an eight-pound bag gives each of four dogs two pounds of food, then a half-pound bag of food gives each of those four dogs one-eighth of a pound. A pitcher holding six cups will provide (6×4) one-fourth–cup servings, and $(6 \times 4) \div 3$ three-fourths–cup servings. Stories, visual models, and the multiplication/division relationship build understanding of the invert-and-multiply rule.

Decimals

Decimals are first introduced as decimal fractions—that is, fractions whose denominators are 10 or 100—and rather than focus on rules for where to place

the decimal point, operations with decimals build on fraction reasoning.

The fraction progression describes a refreshing change from pieces of pie and operations as unexplained and isolated procedures, providing a roadmap that helps students incorporate fractions into their general understanding of number and operations.

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This is *not* your mother's mathematics

BY ROBYN SILBEY, PD AND CAMPUS CONSULTANT

For some of us who attended school in the twentieth century, mathematics was taught and learned as a collection of rules to be memorized and executed without question or examination. Topics were "covered" year after year, building ever so slightly on a teetering foundation until its eventual collapse—or until a teacher unlocked math's mysteries.

The Common Core State Standards for Mathematics (CCSSM) (CCSSI 2010) calls for three key instructional shifts in mathematics that challenge both teachers and students to deeply understand the language and use of mathematics. Math coaches can work with teachers and parents alike to disseminate information about these instructional shifts.

1. **Greater focus on fewer topics**
   Each grade level or course targets a finite, selected group of concepts for the entire year of study. Every concept is examined with deliberate care and in great depth. It is connected to other related concepts and applied in a variety of real-world, problem-solving situations. This increased focus allows time for students to develop a strong foundation with deep conceptual understanding, increased fluency, and the ability to use their knowledge both inside and outside the classroom.
2. **Coherence**
   Linking topics and thinking across grades increases coherence. Standards are designed around a coherent progression from grade to grade. Each year's new knowledge is a deliberate extension of the previous year's learning. In addition, there is coherence in using complementary topics. For example, data displays are embedded as applications of other content topics, rather than as an isolated set of skills.
3. **Rigor**
   Students pursue rigor in daily instruction. *Rigor* refers to deep command of content through equal parts of conceptual understanding, procedural skills and fluency, and application. Content must be developed from different perspectives, using a variety of approaches and strategies, so that it is understood rather than memorized. Core functions, such as basic facts, must be fluent for students to access increasingly complex concepts and procedures. Content must be applied to real-world, engaging contexts to foster motivation and provide relevance.

The Common Core Key Shifts ensure that the mathematics taught in classrooms motivates students to engage with the content and find its relevance in their daily lives. To read more, use the direct link below.
http://www.corestandards.org/other-resources/key-shifts-in-mathematics/
Questions, comments about this article? Contact robyn@robynsilbey.com.